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# PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

### (PCT Article 36 and Rule 70)

Applicant's or agent's file reference 1802-4547 PC	FOR FURTHER ACTION      See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US03/11205	International filing date (day/month/year) 10 April 2003 (10.04.2003)	Priority date (day/month/year) 10 April 2002 (10.04.2002)
International Patent Classification (IPC) or national classification and IPC IPC(7): G01C 3/08 and US Cl.: 356/5.01,5.08,5.04		
Applicant THE JOHNS HOPKINS UNIVERSITY		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.  
 This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of    sheets.

3. This report contains indications relating to the following items:

- I  Basis of the report
- II  Priority
- III  Non-establishment of report with regard to novelty, inventive step and industrial applicability
- IV  Lack of unity of invention
- V  Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI  Certain documents cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

Date of submission of the demand 07 November 2003 (07.11.2003)	Date of completion of this report 20 December 2003 (20.12.2003)
Name and mailing address of the IPEA/US Mail Stop PCT, Attn: IPEA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703)305-3230	Authorized officer JOHN R. LEE 701 James R. Matthews Telephone No. (703) 308-0956

Form PCT/IPEA/409 (cover sheet)(July 1998)

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US03/11205

**I. Basis of the report**

## 1. With regard to the elements of the international application:\*

- the international application as originally filed.  
 the description:

pages 1-17 as originally filed  
 pages NONE, filed with the demand  
 pages NONE, filed with the letter of \_\_\_\_\_.

- the claims:  
 pages 18-20, as originally filed  
 pages NONE, as amended (together with any statement) under Article 19  
 pages NONE, filed with the demand  
 pages NONE, filed with the letter of \_\_\_\_\_.

- the drawings:  
 pages 1-5, as originally filed  
 pages NONE, filed with the demand  
 pages NONE, filed with the letter of \_\_\_\_\_.

- the sequence listing part of the description:  
 pages NONE, as originally filed  
 pages NONE, filed with the demand  
 pages NONE, filed with the letter of \_\_\_\_\_.

## 2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is: .

- the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).  
 the language of publication of the international application (under Rule 48.3(b)).  
 the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

## 3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in printed form.  
 filed together with the international application in computer readable form.  
 furnished subsequently to this Authority in written form.  
 furnished subsequently to this Authority in computer readable form.  
 The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
 The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4.  The amendments have resulted in the cancellation of:

- the description, pages NONE.  
 the claims, Nos. NONE  
 the drawings, sheets/fig NONE.

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.  
PCT/US03/11205**V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. STATEMENT**

Novelty (N)	Claims <u>1-11</u>	YES
	Claims <u>NONE</u>	NO
Inventive Step (IS)	Claims <u>1-11</u>	YES
	Claims <u>NONE</u>	NO
Industrial Applicability (IA)	Claims <u>1-11</u>	YES
	Claims <u>NONE</u>	NO

**2. CITATIONS AND EXPLANATIONS**

Claims 1-11 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest an analog and digital time-of-flight (TOF) system integrated onto a single chip for measuring precise time intervals, the system comprising of first and second constant fraction discriminators for receiving analog start and stop signals and outputting digital signals as start and stop signals to a logic circuit coupled to the two discriminators for determining the time interval between the start/stop signals, and a time-to-digital converter for digitizing the time interval with reference to an off-chip precise reference clock. It is understood that TOF refers to the ability to capture and digitize precise time intervals.

The TOF of the present invention includes all of the analog and digital signal processing necessary for time interval acquisition and digitization in a single monolithic chip. It is a plug-and-play analog (and/or digital) input digital output device that uses very little power and provides good resolution. Apart from the constant fraction discriminators, which measure analog start/stop signals, the second most important functional block includes a time-to-digital converter (TDC) chip, the design of which is generic and covers a broad range of scientific applications utilizing different modes of operation, such as a capability to process both random and triggered events, a low dead time to process event rates up to 1 million/second, temperature stability, and built-in logic to rapidly reject non-valid events, such as double starts/stops.

----- NEW CITATIONS -----